

## Effects of varying dietary ratios of lucerne to maize silage on production and microbial protein synthesis in lactating dairy cows

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**Introduction** Lucerne silage (LS) is high in total CP and rumen degraded protein (RDP) but low in fermentable energy, while maize silage (MS) is a good source of fermentable energy but low in RDP. Thus, these silages are complementary and feeding them at optimum ratio should increase nutrient efficiency in lactating cows. Dhiman & Satter (1997) observed greater milk yield when the dietary forage was 2/3 LS and 1/3 MS. The objective of this experiment was to optimise the dietary LS:MS ratio for production, microbial protein and N utilisation.

**Materials and methods** Twenty-eight (8 with rumen cannulae) multiparous Holstein cows were blocked by days-in-milk and assigned to replicated 4 x 4 Latin squares (28 d periods). The 4 diets were: A (51% LS, 43% high moisture shelled maize (HMSM), and 3% solvent soyabean meal (SSBM)), B (37% LS, 13% MS, 39% HMSM, and 7% SSBM), C (24% LS, 27% MS, 35% HMSM, and 12% SSBM), and D (10% LS, 40% MS, 31% HMSM, and 16% SSBM). Dietary CP was 17.2, 16.9, 16.6, and 16.3%, respectively. Intake and yield of milk and milk components were determined during the last 14 d of each period. Rumen digestion and metabolism, including microbial protein yields, were quantified using omasal sampling (Ahvenjarvi *et al.*, 2000).

**Results** Dry matter intake, yield of milk and fat, and milk fat content decreased linearly when MS replaced LS. Depressed fat yield may have resulted from lower rumen acetate. Milk protein content increased linearly with increasing MS; however, there was a quadratic effect of LS:MS on protein yield with maximum at 31% dietary LS. Nitrogen efficiency increased because N excreted in urine and faeces decreased linearly when MS replaced LS. Production was significantly depressed on LS:MS of 10:40 and microbial non-ammonia N (NAN) flow was lowest on this diet. A quadratic effect also was observed on microbial protein synthesis with maximum at 38% LS, suggesting that maximal microbial protein formation required a balance between fermentable energy and RDP supply.

**Table 1** Effects of dietary ratios of lucerne silage to maize silage (LS:MS) on production and metabolism

Item	LS:MS	51:0	37:13	24:27	10:40	SED	LS:MS
DM intake (kg/d)		26.8 <sup>a</sup>	26.5 <sup>a</sup>	25.4 <sup>b</sup>	23.7 <sup>c</sup>	0.44	R, L
Milk yield (kg/d)		41.5 <sup>a</sup>	42.0 <sup>a</sup>	41.5 <sup>a</sup>	39.5 <sup>b</sup>	0.86	R, L, Q
Milk fat (%)		3.81 <sup>a</sup>	3.58 <sup>ab</sup>	3.38 <sup>bc</sup>	3.34 <sup>c</sup>	0.12	R, L
Milk fat (kg/d)		1.56 <sup>a</sup>	1.51 <sup>ab</sup>	1.40 <sup>bc</sup>	1.33 <sup>c</sup>	0.06	R, L
Milk protein (%)		3.07 <sup>b</sup>	3.13 <sup>ab</sup>	3.14 <sup>ab</sup>	3.17 <sup>a</sup>	0.04	R, L
Milk protein (kg/d)		1.26	1.32	1.30	1.25	0.03	R, Q
Urinary N (g/d)		217 <sup>a</sup>	215 <sup>a</sup>	201 <sup>b</sup>	188 <sup>b</sup>	7.05	R, L
Faecal N (g/d)		275 <sup>a</sup>	263 <sup>a</sup>	230 <sup>b</sup>	211 <sup>b</sup>	10.2	R, L
Rumen ammonia N (mg/dl)		10.5 <sup>a</sup>	10.0 <sup>ab</sup>	8.72 <sup>b</sup>	6.19 <sup>c</sup>	0.92	R, L
Rumen acetate (mM)		88.6 <sup>a</sup>	84.8 <sup>ab</sup>	79.6 <sup>bc</sup>	74.0 <sup>c</sup>	3.46	R, L
Omasal flows							
RDP supply (% of DMI)		11.7 <sup>a</sup>	11.4 <sup>a</sup>	10.5 <sup>b</sup>	10.1 <sup>b</sup>	0.33	R, L
FAB NAN (g/d)		197	219	198	197	15	NS
PAB NAN (g/d)		268	260	261	225	18	NS
Total microbial NAN (g/d)		465 <sup>a</sup>	479 <sup>a</sup>	460 <sup>a</sup>	423 <sup>b</sup>	12	R, L

<sup>a, b, c</sup> Means in the same row with different superscripts differ ( $P \leq 0.05$ ).

<sup>1</sup> R, L, and Q = significant ( $P < 0.05$ ) ratio, linear and quadratic effects; NS = non-significant; SED = standard error of the difference of least square means; FAB = fluid-associated bacteria; PAB = particle associated bacteria.

**Conclusions** The results of this study indicate that maximal milk protein yield and microbial protein supply occurred at dietary LS:MS ratios of 31:19 to 38:12.

### References

- Ahvenjarvi, S., A. Vanhatalo, P. Huhtanen & T. Varvikko (2000). Determination of reticulo-rumen and whole-stomach digestion in lactating cows by omasal canal or duodenal sampling. *British Journal of Nutrition*, 83, 67-77.
- Dhiman, T.R. & L.D. Satter (1997). Yield response of dairy cows fed different proportions of alfalfa silage and corn silage. *Journal of Dairy Science*, 80, 3298-3307.